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ABSTRACT

A model program was developed to increase the number of noncollege-bound students who were capable of succeeding in electronics and laser/electro-optics technology (LET) vocational training. The target population was noncollege-bound disadvantaged students, at least 60 percent minorities and women who were historically underrepresented in technology careers. The Moorpark College/Ventura County Community College District/Business Labor Council Project worked with 8 area high schools to identify students willing to attempt the curriculum designed to fill 2 daily high school periods and a full afternoon at the college laboratory site per week; 98 students completed at least 1 college semester in the program successfully. The curriculum was an integrated mix of electronics, laser-optics, and mathematics. Local businesses donated equipment and illustrative field trips. Findings indicated that 71 percent of students pursued college; 88 percent improved their overall grade average in all high school classes. (The 6-page report is followed by curriculum materials developed by the program, including a course outline for the 35-week course that details specific topics taught at high schools, lecture demonstrations, and laboratory activities at the college with estimated hours, text, and chapter/pages and curriculum objectives. Thirty-five quizzes are also provided.) (YLB)

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Final Report

Non-College Bound Student Demonstration Project in Electronics and Laser-ElectroOptics- In Cooperation with Area High Schools, the Private Industry Council, and the Business Labor Council

Grant Number V199A90040

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submitted by Kathleen Alfano
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Ventura County Community College District
Moorpark, California 93021

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Final Report

Non-College Bound Student Demonstration Project in Electronics and Laser-Electro Optics- In Cooperation with Area High Schools, the Private Industry Council, and the Business Labor Council

Grant Number V199A90040

Summary of Grant Objectives

In June of 1988, Moorpark College and the Business/Labor Council of Ventura County developed a proposal, in cooperation with two county secondary school districts, to develop a model program to increase the number of noncollege bound students who were capable of succeeding in electronics and laser/electro-optics technology (LET) vocational training. Graduates in both of these vocations were in high demand at electronic and electro-optic companies in Ventura County and other areas in Southern California. Evidence of this demand was given in the grant proposal by an attached job market survey and letters of support.

The key component of the project was to upgrade the skills of 100 noncollege bound disadvantaged students, at least 60% minorities and women who are historically underrepresented in technology careers, to be recruited and trained by this model project.

The rationale for the Cooperative Demonstration Project was to provide an alternative to the cycle of poor education-low employment opportunities-low income prevalent in the agricultural areas of Ventura County. The goals of the Project were high : first, to reach out to high school students who were already designated by their high schools as noncollege bound and disadvantaged, either economically or educationally. Second, to provide a curriculum which would allow students to be able to learn specific employable skills and also provide a framework for future advanced training if they were so interested and to keep a lively enough format to interest students who did not normally do well in a lecture-based curriculum. Third, to provide the students in the Project with supportive career counseling to allow them to understand their career alternatives and their own individual strengths and weaknesses. Fourth, to provide students in the Project with the ability to see and experience the high technology opportunites available with Ventura County employers.

Summary of Grant Accomplishments

The Moorpark College/Ventura County Community College District/ Business Labor Council Project successfully worked with eight area high schools to identify over 100 students who fit the qualifications of noncollege bound, disadvantaged students who were willing to attempt a challenging curriculum designed to fill two daily high school periods and a full afternoon at the college laboatory site per week. 98 of these students successfully completed at least one college semester in the program.

The curriculum was an integrated mix of electronics, laser-optics, and mathematics. The curriculum, 14 copies of which are enclosed, provided instruction and materials at both high school and college sites and equipment and illustrative field trips was donated by local businesses. Decision Resources, the Federal Evaluation Contractor, noted that the articulated curriculum between eight high schools and college which provided dual credit was one of the highlights of the model for future replication.

The Project had many successes some intended and some unanticipated. As the Project was ending, economic conditions, especially in the Electronics and Defense industries, worsened. One illustration of the magnitude of the problem was the closing of one of the largest employers in the area, Northrop Aircraft, which will result in many relocations and over 1000 employees being layed off. Many involved in the Project wondered if this would result in a failure of our Project to place students. This did not actually happen. Employers were enthusiastic about employing Project participants with whom they had worked during the employer classroom visits and field trips.

What did change during the Project was the student's goals and self-perception. The majority of the students who completed the Project changed their goal of "maybe finishing school and getting a job" to one of attending college and pursuing high tech and other jobs which would pay better than the minimum wage. As is noted below 71% of Project students pursued college.

Each student's case is individual. The attached news article is illustrative of three of the students whose lives have been changed by completing this Project. We would be happy to put you in touch with any of these individuals if it would help you in understanding the important impact these funds have had. Several of our students were nominated for and received college scholarships-two from a Naval Engineering

Association in Ventura County. Even the students who did not go on to college are appreciative of the electronics skills the Projectwas able to teach them. For example, one student who had a baby during the Project decided to "postpone" college because her skills in electronics offered her a job with medical benefits, which she needed for her new baby. She has stated that the Cooperative Demonstration Project has enabled her to stay off welfare and to remain independent even though she is a single parent and "helped to keep pride in herself".

Attached you will find a number of exhibits which illustrate some of the following accomplishments:

88% of the 98 students in the Project improved their overall grade average in all high school classes in the semesters during which they participated in the Project. High school counselors have reported that most of these students were not expected to graduate, much less go to college with scholarships.

Of the 55 "noncollege bound" High School Seniors in the Project, 38, or 71%, enrolled in college in the Fall following their graduation.

14 out of the 55, 25%, graduating High School Seniors in the Project went on to find fulltime employment.

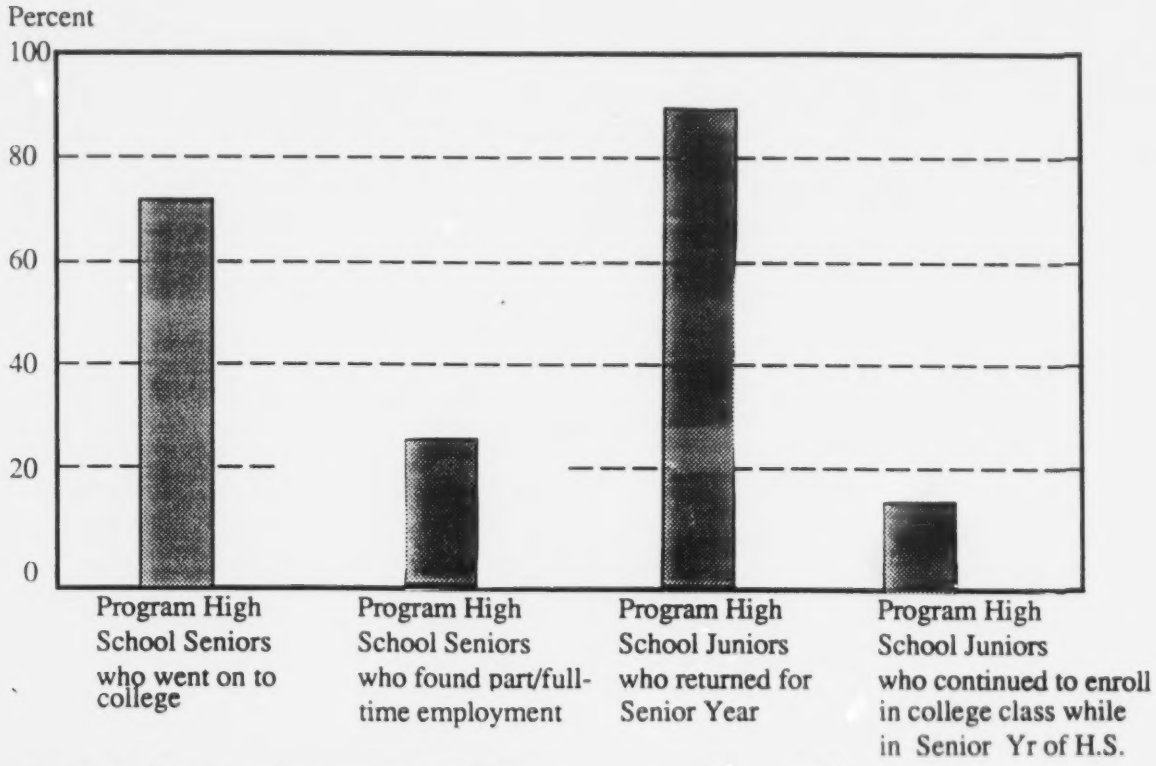
84% of the Project High School Juniors returned for their Senior Year of High School. 14 % of these also continued to take evening college credit classes.

We at Moorpark College are proud of our role in establishing this Cooperative Demonstration Model. It was recognized locally in 18 separate news articles in Ventura County and Los Angeles County and was nominated for the Governor's Award for Achievement in Vocational Education. After the end of grant funding, each of the high schools was able to keep all books, materials, texts and donated equipment and one of the high school districts, the Conejo Valley Unified District was able to self-fund the busing of its high school students out to the College once a week so that the high school-College curriculum model could continue. The two high school teachers who had worked so hard with us both wanted to continue so the high school District rewarded all their effort by allowing both of them to remain team teaching the Electronics and Lasers for another year.

I continue to track the project students as they progress through college and materials on their first year in college will be available by July of

Moorpark College Coop Demo
Student Success Report

Of the 98 students who finished at least one semester of the Moorpark College lab, 55 were high school seniors and 43 were high school juniors. Our final tally on their academic/graduation progress is as follows:



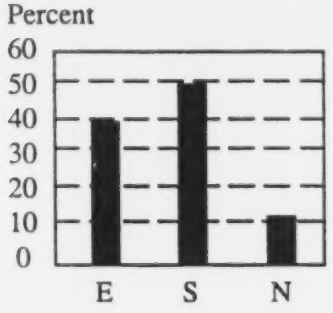
High School Seniors who went on to college	38	71%
High School Seniors who found fulltime employment	14	25%
High School Seniors who dropped out	3	4%
		100%
High School Juniors who returned for their senior year	36	84%
High School Juniors who continued in college nightclasses	6	14%*
High School Juniors who dropped out	4	9%
TOTAL		100%

*These students are also included in the 84% who continued as high school seniors

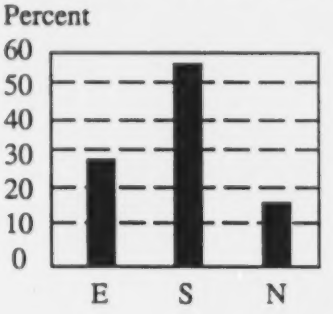
Moorpark College Coop Demo
Student Qualifications in Basic Electronics
Final Evaluations

At the close of the Spring semester, 1990, the finishing students in the program were evaluated in the following skills. The college instructor rated the students as Excellent, Satisfactory or Needs additional Training (E, S or N). 37 students were evaluated and the results (job-related) are as follows:

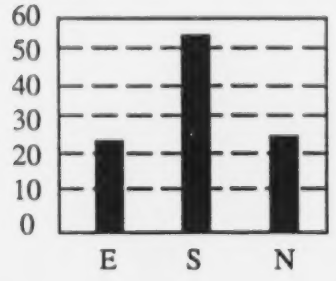
A. Assembly/Disassembly Skills:
E-39%, S-50%, N-11%



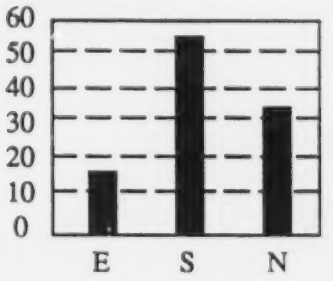
B. Electric Calculations &
Measurements: E-28%, S-56%, N-16%



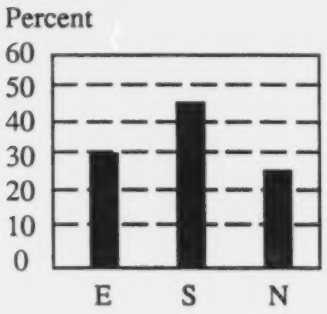
C. AC Circuits:
E - 23%, S-53%, N-24%



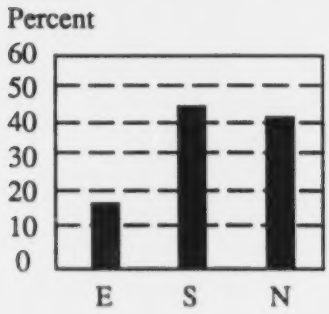
D. Analog Circuits:
E- 14%, S- 53%, N-33%



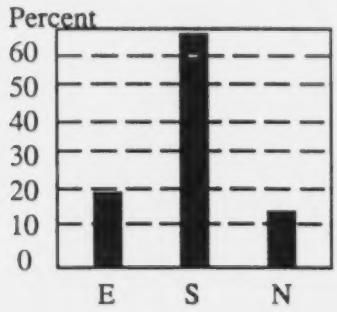
E. Digital Circuits:
E- 30%, S-45%, N-25%



F. Electron Devices:
E-16%, S-43%, N-41%



G. LASER Techniques:
E - 19%, S- 68%, N-13%



Course Outline, Week # 1

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Careers in Electronic	2.0	Haynie	Ch 1
2. Tools & Safety	2.0	Haynie	Ch 2
3. The Order of Places, The Decimal Point, Decimal Fractions, Addition, Subtraction	3.0	Grob	Ch 1, Sec. 1-1 to 1-5
4. Guest Speaker (careers in electronics/laser)	1.0		
Lecture Demonstrations			
1. Video, "Lasers, Light of the 21st Century"			
Lab. Activities (at Moorpark College)			
1. Tour of Lab. Facilities	0.5		
2. Review of Safety Rules	0.5		
3. Careers in Electronics/Tools & Safety	2.0	Haynie	Experiments 1 and 2

Curriculum Objectives - By the end of this week the students will be able to:

1. Identify typical careers in electronics and laser/electro-optics
2. Explain the importance of electronicsand electro-optics in our society.
3. Identify typical tools used by the electronics technician
4. Perform addition and subtraction problems involving decimal fractions with a 90% accuracy rate.

Course Outline, Week # 2

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. What is Electric Current?	2.0	Haynie	Ch. 3
2. Electric Circuits	3.0	Haynie	Ch. 4
3. Multiplication, Division, Moving the Decimal Point	3.0	Grob	Ch. 1, Sec. 1-6 to 1-8
Lecture Demonstrations			
1. Conductivity of various materials (use bulb and battery)			
2. Series bulbs and batteries			
3. Parallel bulbs and batteries			
Lab. Activities (at Moorpark College)			
1. Testing Conductors, Insulators, and Semiconductors	1.5	Haynie	Experiment 3
2. Nature of Electric Circuits	1.5	Haynie	Experiment 4

Curriculum Objectives - By the end of this week the students will be able to:

1. Identify the principle parts of the atom and explain the role of the electron in current flow.
2. List examples of common insulators, semiconductors and conductors.
3. Read schematics to construct simple series and parallel circuits consisting of bulbs and batteries.
4. Perform multiplication and division problems involving decimal fractions with a 90% accuracy rate.

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Course Outline, Week # 3

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Sources of Electricity	5.0	Haynie	Ch 5
2. Percent, Squares & Square Roots, Average Value	3.0	Grob	Ch 1, Sec. 1-9 to 1-11
Lecture Demonstrations 1. Sources of EMF: thermocouple, photovoltaic cell, small generator, chemical reaction, etc. 2. Use of an ammeter.			
Lab. Activities (at Moorpark College) 1. Study the Fluke Digital Multimeter, Current Scale Only 2. Sources of Electricity	1.0 2.0	Haynie	Experiment 5

Curriculum Objectives - By the end of this week the students will be able to:

1. Name various methods of generating EMF.
2. Identify various sources of EMF in everyday situations such as the generator in a car, chemical reactions in a flashlight battery, etc.
3. Perform problems involving %, squares, square roots and average values with a 90% accuracy rate.

Course Outline, Week # 4

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Voltage	3.0	Haynie	Ch 6
2. Current	3.0	Haynie	Ch 7
3. Order of Operations, Rounding Off a Number, Significant Zeroes	2.0	Grob	Ch 1, Sec. 1-13 to 1-15
Lecture Demonstrations			
1. Use of DMM to measure current and voltage in simple circuit using one resistor and one battery			
Lab. Activities (at Moorpark College)			
1. Study the Fluke DMM to Measure Voltage, Review Current Measurements.	0.5		
2. Voltage Measurements	1.25	Haynie	Experiment 6
3. Current Measurements	1.25	Haynie	Experiment 7

Curriculum Objectives - By the end of this week the students will be able to:

1. Explain the difference between voltage and current in terms of electron movement.
2. Define and use the common prefixes for both voltage and current.
3. Explain (at an elementary level) the difference between D.C. and A.C. current.
4. Measure voltage and current with a DMM.
5. Work problems involving order of operation, rounding off and significant zeroes with a 90% accuracy rate.

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Course Outline, Week # 5

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Resistance	2.0	Haynie	Ch. 8
2. Resistor Color Code	1.0	Haynie	Ch. 9
3. Relationship between E, I, R (start Ohm's Law)	2.0	Haynie	Ch. 10
4. Evaluation of Formulas	3.0	Grob	Ch. 1, Sec. 1-16
Lecture Demonstrations 1. Show variety of resistors (including high wattage). 2. Measure resistance using a DMM 3. Measure current with a DMM and demo. Ohm's Law for several simple one resistor circuits.			
Lab. Activities (at Moorpark College)			
1. Study the Fluke DMM to Measure Resistance	0.5		
2. Resistance/Resistors	1.25	Haynie	Experiments 8 & 9
3. Relationship of E, I, R	1.25	Haynie	Experiment 10

Curriculum Objectives - By the end of this week the students will be able to:

1. Explain the concept of electrical resistance and how current is affected by changes in resistance.
2. Measure resistance with a DMM and read the resistor color code using common prefixes for resistance.
3. Work simple Ohm's Law problems using a scientific calculator.
4. With the aid of a calculator, evaluate simple formulas. Students will have a minimum accuracy of 80%.

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Course Outline, Week # 6

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Relationship between E, I, R (finish Ohm's Law)	2	Haynie	Ch. 10
2. Computing Electrical Values	4	Haynie	Ch. 11
3. Positive & Negative Numbers, Addition & Subtraction of Negative Numbers	2	Grob	Ch. 2, Sec. 2-1 to 2-3
Lecture Demonstrations			
1. More examples of Ohm's Law. Sketch schematic on board, measure two variables (out of E, I, R), have students calculate third. Confirm with measurement.			
Lab. Activities (at Moorpark College)			
1. Review Use of Fluke DMM	0.5		
2. Practice computing electrical values. Use additional components to build as many "Haynie-type" circuits as possible	2.5	Haynie	Experiment 11

Curriculum Objectives - By the end of this week the students will be able to:

1. Write Ohm's law and rearrange in order to solve for any of the three variables.
2. Properly use a DMM and a variable D.C. power supply.
3. Solve addition and subtraction problems using negative numbers with an accuracy of at least 95%.

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Course Outline, Week # 7

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Using Calculators to Solve Problems	3.0	Haynie	Ch. 12
2. Elements & Operation of a Laser	3.0	CORD	Mod. 1-1, pgs. 1-6
3. Multiplication & Division of Negative Numbers	2.0	Grob	Ch. 2, Sec. 2-4
Lecture Demonstrations 1. Safely demonstrate a small He-Ne laser. Show how the light output differs from a conventional light source such as a flashlight.			
Lab. Activities (at Moorpark College) 1. Practice Ohm's Law-type calculations using a calculator. Quiz and challenge students to ensure good understanding.	3.0	Haynie	Experiment 12

Curriculum Objectives - By the end of this week the students will be able to:

1. Operate a scientific calculator to solve Ohm's law problems.
2. Understand the concepts of wavelength, monochromaticity, directionality and coherence.

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Course Outline, Week # 8

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Electrical Power	3.0	Haynie	Ch. 13
2. Elements and Operation of a Laser (continued)	2.0	CORD	Mod. 1-1, pgs. 6 to 15
3. Multiplication & Division of Fractions	3.0	Grob	Ch. 3, Sec. 3-1 to 3-2
Lecture Demonstrations 1. Show power rating sticker on a variety of common small applicance. Have students estimate the average (RMS) current flowing into each applicance assuming an an average voltage of 110 VAC. Don't attempt a formal definition of RMS yet (see Chapter 28 in Haynie).			
Lab. Activities (at Moorpark College) 1. Perform experiments on electrical power. Contrast the manner in which an ammeter and voltmeter are inserted in a circuit.	3.0	Haynie	Experiment 13

Curriculum Objectives - By the end of this week the students will be able to:

1. Define the term "power" and be familiar with the common units of measurement of power including prefixes.
2. Explain the concepts of atomic energy levels, spontaneous and stimulated emission and absorption of light.
3. Work multiplication and division problems involving fractions with an accuracy of at least 80%.

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Course Outline, Week # 9

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Series Circuits	3.0	Haynie	Ch. 14
2. Elements and Operation of a Laser (continued)	2.0	CORD	Mod. 1-1, pgs. 9 to 15
3. Reducing Fractions, Multiplying and Dividing Fractions by a Whole Number	3.0	Grob	Ch. 3, Sec. 3-3 to 3-4
Lecture Demonstrations 1. Show a variety of laser resonator and head parts. 2. Demonstrate a small running He-Ne laser with the operational parts exposed (safely!). College staff can assist if required.			
Lab. Activities (at Moorpark College)			
1. Wire and test simple D.C. circuit.	3.0	Haynie	Experiment 14

Curriculum Objectives - By the end of this week the students will be able to:

1. Work simple series resistor circuits using Ohm's law and a scientific calculator.
2. Name and identify the basic parts of a simple laser.
3. Work problems involving reduction of fractions and multiplication and division of fractions by a whole number with an accuracy of at least 85%.

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Course Outline, Week # 10

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Parallel Circuits	4.0	Haynie	Ch. 15
2. Addition & Subtraction of Fractions	4.0	Grob	Ch. 3, Sec. 3-5
Lecture Demonstrations 1. Demonstrate current "branching" in a parallel resistor circuit using a DMM. Sketch circuit on board and have students calculate current through each branch, check with DMM.			
Lab. Activities (at Moorpark College)			
1. Wire and Test Simple D.C. Parallel Circuits	2.0	Haynie	Experiment 15
2. Review Series Circuits, Compare with Parallel Circuits	1.0		

Curriculum Objectives - By the end of this week the students will be able to:

1. Define and recognize parallel circuits.
2. Calculate current in each branch of a simple pa rallel circuit.
3. Calculate the effective total resistance for a parallel circuit.
4. Work problems involving addition and subtraction of fractions with an accuracy of at least 90%.

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Course Outline, Week # 11

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Series/Parallel Circuits	3.0	Haynie	Ch. 16
2. Safety Devices	1.5	Haynie	Ch. 17
3. Laser Safety	1.5	CORD	Mod. 1, pgs. 16 to 17
4. Negative Fractions	2.0	Grob	Ch. 3, Sec. 3-6
Lecture Demonstrations 1. Pass around examples of safety devices used in the electronics and laser/electro-optics industries. Discuss function and appropriate use of each.			
Lab. Activities (at Moorpark College) 1. Wire and Test D.C. Series-Parallel Circuits 2. Start small group tours of laser labs.	3.0	Haynie	Experiment 16

Curriculum Objectives - By the end of this week the students will be able to:

1. Recognize series and parallel elements in "mixed" circuits. Know how to calculate the effective total resistance.
2. Identify and explain how to properly utilize typical safety devices used in the electronics and laser industries.
3. Be able to work problems involving negative fractions with an accuracy of at least 90%.

Course Outline, Week # 12

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Magnetism	2.5	Haynie	Ch. 18
2. Electromagnetism	2.5	Haynie	Ch. 19
3. Reciprocals and Decimal Fractions	1.5	Grob	Ch. 3, Sec. 3-7
4. Working with Decimal Fractions	1.5	Grob	Ch. 3, Sec. 3-8
Lecture Demonstrations 1. Demonstrate magnetic forces on a beam of electrons using a permanent magnet and an oscilloscope. 2. Show E-M induction with a permanent magnet, coil and an oscilloscope.			
Lab. Activities (at Moorpark College)			
1. Safety Devices	1.0	Haynie	Experiment 17
2. Magnetism/Electromagnetism	2.0	Haynie	Experiments 18 & 19
3. Continue small group tours of laser labs.			

Curriculum Objectives - By the end of this week the students will be able to:

1. Understand, at an introductory level, the theory of permanent and electro-magnets.
2. Be able to define terms such as "saturation", "domains", "permeability", "solenoid", etc.
3. Explain, in simple terms, under what circumstances a magnetic field is observed and in what direction it points.
4. Be able to work problems involving reciprocals and decimal fractions with an accuracy of at least 85%.

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Course Outline, Week # 13

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Meters	2.0	Haynie	Ch. 20
2. Simple Current Meters	3.0	Haynie	Ch. 21
3. Positive Exponents, Roots of Positive Numbers & Digits	3.0	Grob	Ch. 4, Sec. 4-1 to 4-3
Lecture Demonstrations			
1. Show a variety of different analog and digital meters.			
2. Demonstrate the use of a current meter in a simple circuit.			
Lab. Activities (at Moorpark College)			
1. Meters	1.5	Haynie	Experiment 20
2. Current Meters	1.5	Haynie	Experiment 21
3. Finish small group tours of laser labs.			

Curriculum Objectives - By the end of this week the students will be able to:

1. List the basic types of meters used in electronics.
2. Understand the effect meter accuracy has on measured values.
3. Utilize an analog or digital current meter in simple series and parallel circuits.
4. Work problems involving positive exponents & roots of positive numbers & digits with an accuracy of at least 80%.

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Course Outline, Week # 14

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Simple Voltage Meters	3.0	Haynie	Ch. 22
2. Simple Resistance Meters	2.0	Haynie	Ch. 24
3. Powers & Roots of Negative Numbers	3.0	Grob	Ch. 4, Sec. 4-4 to 4-5
Lecture Demonstrations			
1. Use of Volt and Ohm meters in simple D.C. resistor circuits. Emphasize by demonstration how a Volt meter and an Ammeter are connected differently in a circuit.			
Lab. Activities (at Moorpark College)			
1. Voltmeters	1.5	Haynie	Experiment 22
2. Resistance Meters	1.5	Haynie	Experiment 23

Curriculum Objectives - By the end of this week the students will be able to:

1. Properly connect and read the scales of Volt and Ohm meters utilized in simple D.C. circuits.
2. Explain the difference between current and voltage meters.
3. Work problems involving powers and roots of negative numbers with an accuracy of at least 90%.

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Course Outline, Week # 15

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Multimeters	2.0	Haynie	Ch. 24
2. Electronic ("Digital") Meters	2.0	Haynie	Ch. 25
3. Powers and Roots	4.0	Grob	Ch. 4, Sec. 4-6 to 4-8
Lecture Demonstrations 1. Show various types of analog and digital multimeters. 2. Carefully show the use of a high voltage probe with a DMM and a current probe with either a DMM and/or an oscilloscope.			
Lab. Activities (at Moorpark College)			
1. Multimeters	1.5	Haynie	Experiment 24
2. Electronic Meters	1.5	Haynie	Experiment 25
3. First half of class starts Laser Power & Irradiance Lab.	2.0	CORD	Mod. 1-2, pgs. 47 to 49

Curriculum Objectives - By the end of this week the students will be able to:

1. Correctly utilize the scales on a variety of analog and digital multimeters.
2. Understand the safe use of high voltage probes and current probes.
3. Work problems involving powers and roots with an accuracy of at least 85%.

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Course Outline, Week # 16

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Batteries	1.0	Haynie	Ch. 26
2. Generators and Alternators	2.0	Haynie	Ch. 27
3. Elements & Operation of an Optical Power Meter	3.0	CORD	Mod. 1-2, pgs. 26 to 34
4. Squares & Roots with Terms, Using a Calculator	2.0	Grob	Ch. 4, Sec. 4-9 to 4-10
Lecture Demonstrations			
1. Show batteries of a variety of physical sizes and ratings.			
2. Operate a small A.C. and/or D.C. generator connected to an oscilloscope.			
3. Show a simple optical power meter with a He-Ne laser.			
Lab. Activities (at Moorpark College)			
1. First half of class finishes last week's experiments.	2.0		
2. Second half of class does Laser Power & Irradiance lab.	2.0	CORD	Mod. 1-2, pgs. 47 to 49
3. All of class does Batteries Lab.	1.0	Haynie	Experiment 26

Curriculum Objectives - By the end of this week the students will be able to:

1. Connect various cells and batteries in order to obtain the desired voltage and current values.
2. Understand the basic electrical ratings of disposable and rechargable batteries.
3. Understand the operation of a basic optical power meter and terms such as "optical power" and "irradiance".
4. Work problems involving squares and roots of terms and powers & roots using a calculator with an accuracy of at least 85%.

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Course Outline, Week # 17

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Alternating Current (A.C.)	4.0	Haynie	Ch. 28
2. Positive Exponents of 10, Converting to Powers of 10	4.0	Grob	Ch. 5, Sec. 5-1 to 5-3
Lecture Demonstrations			
1. Display A.C. signals on an oscilloscope using a signal generator; discuss amplitude, wavelength, frequency.			
Lab. Activities (at Moorpark College)			
1. Generators/Alternators	1.0	Haynie	Experiment 27
2. Alternating Current (A.C.)	2.0	Haynie	Experiment 28

Curriculum Objectives - By the end of this week the students will be able to:

1. Define terms such as "amplitude", "frequency", "RMS", "phase".
2. Distinguish between A.C. and D.C. voltage and current.
3. Measure RMS and peak-to-peak voltages and currents with a DMM and understand the difference.
4. Work problems involving positive exponents of 10 and converting to powers of 10 with an accuracy of at least 90%.

Course Outline, Week # 18

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Oscilloscopes	5.0	Haynie	Ch. 29
2. Multiplication & Division with Powers of 10	3.0	Grob	Ch. 5, Sec. 5-4 to 5-5
Lecture Demonstrations 1. Show a basic oscilloscope, explain use of various controls.			
Lab. Activities (at Moorpark College) 1. Oscilloscopes	3.0	Haynie	Experiment 29

Curriculum Objectives - By the end of this week the students will be able to:

1. Properly operate the controls on a basic "student" oscilloscope.
2. Understand concepts such as vertical gain, sweep rate, trigger level, etc.
3. Perform voltage, time and frequency measurements using an oscilloscope.
4. Work problems involving multiplication and division with powers of 10, with an accuracy of at least 90%.

Course Outline, Week # 19

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Transformers	3.0	Haynie	Ch. 30
2. Inductance (start topic)	2.0	Haynie	Ch. 31
3. Reciprocals and Addition & Subtraction with Powers of 10	3.0	Grob	Ch. 5, Sec. 5-6 to 5-7
Lecture Demonstrations			
1. Show examples of both step up and step down transformers (safe to demonstrate using signal generator and oscilloscope).			
Lab. Activities (at Moorpark College)			
1. Transformers	1.5	Haynie	Experiment 30
2. Inductance	1.5	Haynie	Expt. 31 (Steps 1 to 4)

Curriculum Objectives - By the end of this week the students will be able to:

1. Understand, at an elementary level, the operating principle of transformers and inductors.
2. Understand the difference between "step up" and "step down" transformers.
3. Name the important methods of power loss in a transformer.
4. Work problems involving reciprocals and addition and subtraction of powers of 10 with an accuracy of at least 90%.

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Course Outline, Week # 20

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Inductance (finish topic)	2.0	Haynie	Ch. 31
2. RL Time Constant	3.0	Haynie	Ch. 32
3. Other Operations with Powers of 10, Combined Operations	3.0	Grob	Ch. 5, Sec. 5-8 to 5-11
Lecture Demonstrations 1. Use a full-wave bridge (no filter cap.), an oscilloscope and various inductors to show the use of an inductor as a "choke".			
Lab. Activities (at Moorpark College)			
1. Inductance	1.0	Haynie	Expt. 31 (Steps 5 & 6)
2. RL Time Constant	2.0	Haynie	Experiment 32

Curriculum Objectives - By the end of this week the students will be able to:

1. Understand how the RL time constant affects the current vs. time grap in a simple D.C. circuit.
2. Work a variey of problems involving powers of 10 with an accuracy of at least 90%.

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Course Outline, Week # 21

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Inductive Reactance	2.5	Haynie	Ch. 33
2. Capacitance (start topic)	2.0	Haynie	Ch. 34
3. Logarithms	2.0	Grob	Ch. 6, Sec 6-1 to 6-3
4. Laser Safety (start topic)	1.5	CORD	Mod. 1-3
Lecture Demonstrations			
1. Show structure of human eye using plastic model, relate to laser safety.			
Lab. Activities (at Moorpark College)			
1. Inductive Reactance	1.5	Haynie	Experiment 33
2. Capacitance	1.5	Haynie	Experiment 34

Curriculum Objectives - By the end of this week the students will be able to:

1. Understand the concept of capacitance, the units of capacitance and be able to list the basic types of capacitors.
2. Work problems involving logarithims with an accuracy of at least 90%.
3. Understand the basic rules regarding safe operation of a laser.

Course Outline, Week # 22

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Capacitance (finish topic)	2.0	Haynie	Ch. 34
2. RC Time Constant	2.0	Haynie	Ch. 35
3. Antilogs, Log Graph Paper, Decibles	3.0	Grob	Ch. 6, Sec. 6-4 to 6-6
4. Laser Safety (finish topic)	1.0	CORD	Mod. 1-3
Lecture Demonstrations 1. Charge and discharge of a large capacitor using a d.c. power supply, series resistor and a voltmeter. 2. Display a variety of laser goggles, discuss proper use of each type.			
Lab. Activities (at Moorpark College)			
1. RC Time Constant/Capacitive Reactance	3.0	Haynie	Expts. 35 and 36
2. Laser Eye Safety Lab. (first half of students)	3.0	CORD	Mod. 1-3, pgs. 65 - 67

Curriculum Objectives - By the end of this week the students will be able to:

1. Understand RC time constants and be able to perform basic RC time constant calculations.
2. Perform calculations involving antilogs and decibles with a 90% accuracy rate.
3. Be able to plot data on both log-log and semilog graph paper.
4. Understand the laser classification system and how to operate a laser system safely.

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Course Outline, Week # 23

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Capacitive Reactance	3.0	Haynie	Ch. 36
2. Resonance (start topic)	2.0	Haynie	Ch. 37
3. Natural Logarithms	3.0	Grob	Ch. 6, Sec. 6-7
Lecture Demonstrations 1. Show voltage phase relationship in a series LRC circuit using a signal generator and an oscilloscope.			
Lab. Activities (at Moorpark College)			
1. Resonance	3.0	Haynie	Experiment 37
2. Laser Eye Safety Lab. (second half of students)	3.0	CORD	Mod. 1-3, pgs. 65-67

Curriculum Objectives - By the end of this week the students will be able to:

1. Understand the concept of capacitive reactance, be able to perform simple calculations involving reactance.
2. Understand the concept of series circuit resonance.
3. Be able to perform calculations involving natural logs. with an accuracy of at least 90%.

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Course Outline, Week # 24

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Resonance (finish topic)	1.0	Haynie	Ch. 37
2. Series Resonant Circuits	2.0	Haynie	Ch. 38
3. Parallel Resonant Circuits	2.0	Haynie	Ch. 39
4. Metric System (start topic)	3.0	Grob	Ch. 7, Sec. 7-1 to 7-4
Lecture Demonstrations 1. Demonstrate resonance of both series and parallel LRC circuits using a signal generator and oscilloscope. 2. Show a kilogram "weight", meterstick, liter beaker, etc.			
Lab. Activities (at Moorpark College)			
1. Series Resonance	1.5	Haynie	Experiment 38
2. Parallel Resonance	1.5	Haynie	Experiment 39

Curriculum Objectives - By the end of this week the students will be able to:

1. Understand the concept of resonance in both series and parallel circuits using vector (phasor) diagrams.
2. Be able to calculate impedance for simple series and parallel circuits.
3. Understand the concept of voltage and current phase shift in passive A.C. circuits.
4. Understand the basic units and prefixes used in the metric system and how to perform unit conversion.

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Course Outline, Week # 25

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Diodes	2.0	Haynie	Ch. 40
2. Power Supplies (start topic)	2.0	Haynie	Ch. 41
3. Metric System (finish topic)	1.0	Grob	Ch. 7, Sec. 7-5 to 7-6
4. Properties of Light	3.0	CORD	Mod. 1-4, pgs. 70 - 81 and 84 - 85 (skip trig.)
Lecture Demonstrations			
1. Demonstrate the action of a diode using a battery, resistor and a current meter (or small light bulb).			
Lab. Activities (at Moorpark College)			
1. Diodes	2.0	Haynie	Experiment 40
2. Power Supplies (introduction)	1.0	Haynie	Experiment 41 (start)

Curriculum Objectives - By the end of this week the students will be able to:

1. Understand the operating principles of a diode and how to utilize diodes in simple circuits.
2. Understand the metric units of power, work, energy, temperature and how to perform unit conversion.
3. Be able to define terms such as wavelength, frequency, period, propagation speed, amplitude, phase, polarization, and state how these terms are applied to a study of the wave properties of light.

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Course Outline, Week # 26

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Power Supplies (finish topic)	2.0	Haynie	Ch. 41
2. Vacuum Tubes	2.0	Haynie	Ch. 42
3. Intro. to Algebra, Literal Numbers	2.0	Grob	Sec. 8-1 to 8-3
Lecture Demonstrations 1. Demonstrate a half-wave and full-wave bridge rectifier using diodes, a signal generator, filter caps and an oscilloscope. 2. Show polarization of light using polaroid filters.			
Lab. Activities (at Moorpark College)			
1. Power Supplies	1.5	Haynie	Experiment 41 (finish)
2. Polarization of light experiment.	1.5	handout	

Curriculum Objectives - By the end of this week the students will be able to:

1. Understand the operation of rectifier bridge circuits and how they are utilized in simple D.C. power supplies.
2. Add, subtract and raise literal numbers to a power with an accuracy of at least 90%.
3. Understand the concept of linearly polarized light and be able to conduct laboratory measurments utilizing a small laser, polarizing filters and an optical power meter.

Course Outline, Week # 27

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Transistors	6.0	Haynie	Ch. 43
2. Literal Numbers (continued)	2.0	Grob.	Sec. 8-4 to 8-6
Lecture Demonstrations 1. Show amplification using a simple one transistor circuit, a signal generator and an oscilloscope.			
Lab. Activities (at Moorpark College) 1. Transistors	3.0	Haynie	Experiment 43

Curriculum Objectives - By the end of this week the students will be able to:

1. Understand the manner in which transistors amplify signals.
2. Understand how to utilize transistors in simple circuits.
3. Work problems involving: multiplying and dividing literal numbers, fractions with literal numbers and terms and factors with an accuracy of at least 90%.

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Course Outline, Week # 28

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Light Sensitive Elements	2.0	Haynie	Ch. 44
2. Other Semiconductor Devices	2.0	Haynie	Ch. 45
3. Polynomials, Simplifying Literal Fractions, Binomials, Factoring	4.0	Grob	Sec. 8-7 to 8-10
Lecture Demonstrations 1. Demonstrate current produced by a photocell. 2. Show the output of a PIN diode using a chopped He-Ne beam, an op amp (or transistor) and an oscilloscope. 3. Demonstrate other devices such as FET, SCR, diac, etc.			
Lab. Activities (at Moorpark College) 1. Light Sensitive Components	3.0	Haynie	Experiment 44

Curriculum Objectives - By the end of this week the students will be able to:

1. Understand the action and application of light sensitive devices such as photocells, photodiodes, phototransistors, photoresistors and phototubes.
2. State the purpose and use of other semiconductor devices such as diacs, SCRs, FETs, etc.
3. Work problems involving: polynomials, literal fractions, binomials and factoring with an accuracy of at least 90%.

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Course Outline, Week # 29

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Digital Electronics (start topic)	5.0	Haynie	Ch. 46
2. Computer Mathematics (start topic)	3.0	Grob.	Sec. 12-1 to 12-5
Lecture Demonstrations 1. Show the operation of some simple logic gates using the gates in conjunction with small light bulbs.			
Lab. Activities (at Moorpark College) 1. Other Semiconductor Devices	3.0	Haynie	Experiment 45

Curriculum Objectives - By the end of this week the students will be able to:

1. Understand the operation and truth tables for: AND, OR, NAND, NOR gates, inverters, and flip-flops and how these gates can be used to form logic circuits.
2. Work problems involving binary arithmetic with an accuracy of at least 90%.

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Course Outline, Week # 30

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Digital Electronics (finish topic)	2.0	Haynie	Ch. 46
2. Integrated Circuits	1.0	Haynie	Ch. 47
3. Computer Hardware and Software	1.0	Haynie	Ch. 48
4. Amplifiers (start topic)	1.0	Haynie	Ch. 49
5. Computer Mathematics (finish topic)	3.0	Grob	Sec. 12-6 to 12-9, optional 12-17 to 12-19
Lecture Demonstrations 1. Show the class a variety of different I.C.'s, demonstrate one or more of them operating, if possible. 2. Show an I.C. with it's top removed under a microscope.			
Lab. Activities (at Moorpark College) 1. Digital Electronics	3.0	Haynie	Experiment 46

Curriculum Objectives - By the end of this week the students will be able to:

1. Understand the purpose of integrated circuits and how I.C.'s relate to individual circuit elements such as resistors, capacitors, transistors, etc.
2. Understand the basic function of each major component (CPU, I/O, monitor, etc.) of a computer.
3. Work problems involving binary arithmetic with an accuracy of at least 90%.

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Course Outline, Week # 31

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Amplifiers (finish topic)	2.0	Haynie	Ch. 46 49
2. Putting Amplifier Stages Together	1.0	Haynie	Ch. 50
3. Oscillators	1.0	Haynie	Ch. 51
4. Methods of Solving Equations (start topic)	1.0	Grob	Sec. 9-1 to 9-2
5. Emission and Absorption of Light	3.0	CORD	Mod. 1-5
Lecture Demonstrations 1. Construct and demonstrate multi-stage amp. in Fig. 50-1 of Haynie, page 322. 2. Construct and demonstrate a one transistor oscillator. 3. Show emission spectra of gasses with diffraction gratings.			
Lab. Activities (at Moorpark College) 1. Computer Hardware	3.0	Haynie	Experiment 48 Schematic 48-1 *only*.

Curriculum Objectives - By the end of this week the students will be able to:

1. Understand how to couple multi-stage amplifiers together.
2. Understand how an amplifier can be made to oscillate.
3. Solve simple equations by performing addition, subtraction, multiplication, and division operations on both sides with an accuracy of at least 90%.
4. Understand the emission and absorption of light by atoms utilizing simplified energy level diagrams.

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Course Outline, Week # 32

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Emission and Absorption of Light (finish topic)	2.0	CORD	Mod. 1-5
2. Power for Heating	1.0	Haynie	Ch. 52
3. Power for Lighting	1.0	Haynie	Ch. 53
4. Power for Motors	1.0	Haynie	Ch. 54
5. Solving Equations (continued)	3.0	Grob.	Sec. 9-3 to 9-4
Lecture Demonstrations 1. Display a variety of heating elements (toster, hair dryer), light bulb filaments, discharge lamps, etc. 2. Disassemble an electric motor and discuss the parts, how are A.C. and D.C. motors different?			
Lab. Activities (at Moorpark College)			
1. Amplifiers	1.5	Haynie	Experiment 49
2. Spectrometer, emission and absorption spectra	1.5	CORD	Mod. 5-1 pgs. 113-117 (skip step 4, pg. 114)

Curriculum Objectives - By the end of this week the students will be able to:

1. Calculate the energy of a photon knowing either the wavelength or frequency and convert the answer into various common energy units with an accuracy of at least 90%.
2. Understand how electrical power is utilized in heating elements, light bulbs and electric motors.

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Course Outline, Week # 33

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Communication by Telephone	1.0	Haynie	Ch. 55
2. Communication by Radio	1.0	Haynie	Ch. 56
3. Communication by Television	1.0	Haynie	Ch. 57
4. Simultaneous Linear Equations	3.0	Grob	Ch. 10
5. Lasing Action (start topic)	2.0	CORD	Mod. 1-6
Lecture Demonstrations 1. Show Beer's law using a gelatin filter set, small He-Ne and an optical power meter. 2. Shown the additive property of ND filters using set up above.			
Lab. Activities (at Moorpark College) 1. Oscillators	3.0	Haynie	Experiment 51

Curriculum Objectives - By the end of this week the students will be able to:

1. Understand the basic principles of transmission and reception of signals over telephone, radio & T.V. systems.
2. Work problems involving simultaneous linear equations with an accuracy of at least 90%
3. Understand the principle of absorption and emission of light.
4. Work numerical examples of Beer's law problems with an accuracy of at least 90%.

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Course Outline, Week # 34

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Other Forms of Electronic Communications	0.5	Haynie	Ch. 58
2. Industrial Control	1.0	Haynie	Ch. 59
3. Data Processing	1.0	Haynie	Ch. 60
4. Robotics	1.0	Haynie	Ch. 61
5. Trigonometry (start topic)	2.5	Grob	Sec. 11-1 to 11-4
6. Lasing Action (finish topic)	2.0	CORD	Mod. 1-6
Lecture Demonstrations			
1. Show simple examples of sensing & control devices such as a mercury switch, thermocouple, photo-relay for a burgler alarm, etc.			
Lab. Activities (at Moorpark College)			
1. Exponential Law of Absorption/Laser Gain	3.0	CORD	Pgs. 136-140

Curriculum Objectives - By the end of this week the students will be able to:

1. Understand the concepts of: industrial control systems, data processing and robotics.
2. Work simple problems involving sin, cos and tan with an accuracy of at least 90%

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Course Outline, Week # 35

Specific Topics (taught at High Schools)	Est. Hrs.	Text	Chapter/pages
1. Electronics in the Automobile	1.0	Haynie	Ch. 62
2. House Wiring	1.0	Haynie	Ch. 63
3. Appliance Repair	0.5	Haynie	Ch. 64
4. Trigonometry (finish topic)	3.0	Grob	Ch. 11
5. Cleaning Optical Components/Laser Alignment	2.5	CORD	pgs. 160-165
Lecture Demonstrations 1. Show parts from an automobile igintion system. 2. Drive ignition spark coil with SCR discharge circuit, show discharge across electrodes of a spark plug. (Be careful of high voltage!)			
Lab. Activities (at Moorpark College)			
1. Cleaning of Optical Components	1.0	CORD	pgs. 160-162
2. Alignment of the Optical Cavity	2.0	CORD	pgs. 162-165

Curriculum Objectives - By the end of this week the students will be able to:

1. Understand the basic principles of automotive and residential wiring.
2. Understand the basic principles and safety procedures associated with appliance repair.
3. Work problems in right triangle trigonometry with an accuracy of at least 90%.
4. Properly clean and align an open-cavity He-Ne laser resonator.

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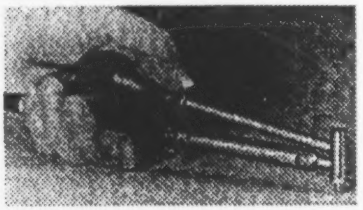
Moorpark College
Electronics Technology

Student's Name: (Print Last, First) _____

/10
score

Quiz # 1

1. **What is the purpose of the tool shown on the right?**



_____

_____

/2

2. **List four careers (other than electronics or electrical engineering) that use a significant number of modern electronic devices.**

_____ _____

_____ _____

/2

3. **Explain what is meant by the "one-hand rule".**

_____

_____

_____

_____

/2

4. **In the number 1,234.5678 circle the digit that resides in the thousandths place.**

/2

5. **Work the following problem: 1,312.85 - 248.79 = _____**

/2

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Electronics Technology

Student's Name: (Print Last, First) _____

/10
score

Quiz # 2

1. All atoms have positive nuclei and negative electrons. All matter is made of atoms, but some materials are conductors and others are insulators of electricity. Explain why: _____

_____

_____

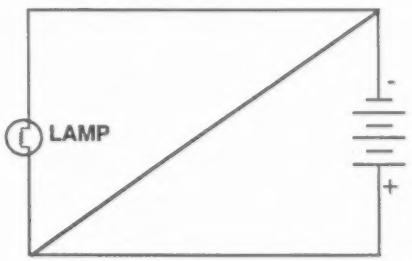
/2

2. The teacher asks the student: "Why does the lamp-cord have two wires?" The student replies: "One of the wires is a spare!" Do you agree with the student's response? YES NO (circle one)

/2

3. Use arrows to show the path of electrons in the circuit on the right.
Is the circuit: COMPLETE, INCOMPLETE, SHORTED, OPEN ?

(circle the correct answers)



/2

4. a) 6.4 x 3.7 = _____ b) 23.8 ÷ 6.4 = _____

/2

5. a) 69.46 x 100 = _____ b) 6.48 ÷ 1000 = _____

/2

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Moorpark College
Electronics Technology

Student's Name: (Print Last, First) _____

/10
score

Quiz # 3

1. List four different sources of EMF ("electromotive force" or "voltage").

_____

_____ /2

2. In the box on the right, draw the symbol for a cell (not a "battery"). Clearly label the positive and negative terminals of the cell.

/2

3. Name a device (except a power generator) that converts mechanical energy directly into electrical energy.

_____ /2

In the last two problems, fill in the blanks in each case.

4. a. 0.007 = _____ %

   b. $\sqrt{64}$ = _____ /2

5. a. Find the average value of the numbers: 4, 6, 8

   average = _____

   b. Find the RMS value of the same three numbers
   (you may use a claculator and write the answer only to the hundredths place).

   RMS = _____ /2

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Quiz # 4

1. 0.024 V is the same as,

   a. 24 kilovolts b. 24 millivolts c. 24 microvolts

   d. 24 megavolts e. None of these (circle one answer)

/2

2. State the basic difference between direct current (DC) and alternating current (AC).

_____

_____

/2

3. List three things that are wrong with Figure 7-1.

_____

_____

_____

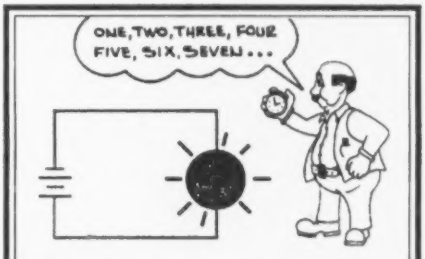

Fig. 7-1 Current has to do with the number of electrons which flow through the circuit each second.

/2

4. Work the following problem:

$$\frac{(9-4)^2}{5} + 6.8 =$$

/2

5. Round off to the nearest thousandths:

   a. 6.89486 = b. 0.0699 =

/2

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Quiz # 5

1. In the box on the right, draw the symbol for a potentiometer

/2

2. Starting from the left, the bands of the resistor have the colors: brown, green, red, silver. What is the resistance and tolerance of the resistor?

R = _____ ohms, +/- _____ %

/2

3. Evaluate the following expressions:

   a. $3 \times 2^2 + 5 =$ _____

   b. $16 \div 4^2 - 1 =$ _____

/2

In the following two problems evaluate Ohm's Law (V = IR) for the unknown quantity, given the values of the other two. Put you answer in the blank space.

4. R = 1000 ohms, V = 10 volts, I = _____ amperes

/2

5. V = 9.0 volts, I = 0.010 amperes, R = _____ ohms

/2

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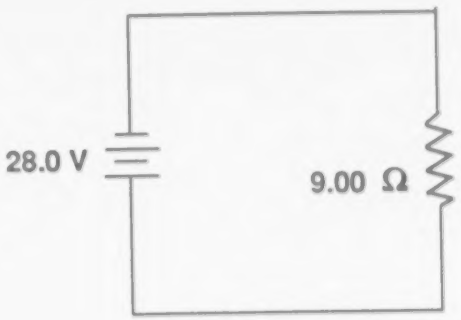
Quiz # 6

1. What is the current through the resistor? _____

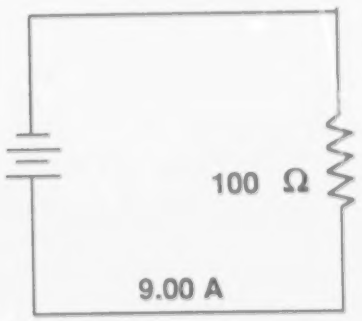
   What is the current through the battery? _____



/2

2. What is the voltage of the source of EMF? _____

   Show the direction of electron on the schematic on the right.



/2

3. The resistance of the windings in the starter motor of a car is 0.100 Ω. If the battery voltage is 13.0 volts, what is the current through the motor when the circuit is complete? Sketch the circuit in the box on the right.

put sketch in here

/2

4. $-6 + (-0.8) + 0.6 =$ _____

   $8.4 + 6.9 + (-3) =$ _____

/2

5. $6 - (-6) + 1.2 - 2.8 =$ _____

   $-4.8 - 6 + (-3.9) =$ _____

/2

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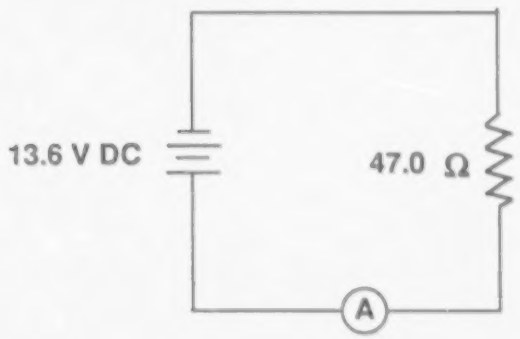
Quiz # 7

Use a calculator to solve the following problems:

1. **A 47.0 Ω resistor is connected to a 13.6 volt battery as shown in the figure below. Find the current through the ammeter.**



I = _____ Amps. /2

2. **Consider a circuit similar to the one above except this time we know that the current is 11.6 A while the battery has a voltage of 6.00 V DC. What is the value of the resistance?**

R = _____ Ω /2

3. **Consider another similar circuit in which the current is 3.50 A and the resistance is 170 Ω . What is the voltage of the battery?**

V = _____ volt /2

4. **Using your calculator, solve the following:**

$$\frac{(3.75 - 4.86)}{(2.20)(-4.23)} = \_\_\_\_\_$$ /2

5. **And also the following:**

$$\frac{(-3.35)(-2.00)}{-5.56} = \_\_\_\_\_$$ /2

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Quiz # 8

1. **A He-Ne laser "uses" 6.00 mA when it is connected to a power supply of 0.975 kV. How much power (in watts) is used by the laser?** /2

P = _____ watts

2. **What is the (hot) resistance of the filament of a 75.0 watt light bulb that is connected to a 120 volt wall outlet?** /2

R = _____ ohms

3. **Explain the meaning of the work "dissipate" as it relates to the electrical power in a resistor in an electrical circuit. Is the electrical energy really "lost"?** /2

_____
_____
_____
_____

4. **Solve the following:** /2

$$\frac{3}{4} \times \frac{1}{2} \times \frac{2}{3} =$$

$$\frac{7}{8} \times \frac{8}{7} =$$

5. **And the following:** /2

$$\frac{2}{3} \div \frac{3}{2} =$$

$$\frac{16}{22} \div \frac{2}{8} =$$

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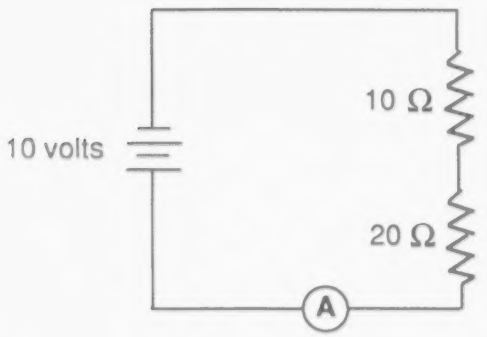
Quiz # 9

1. **Find the current through the battery in the circuit below:**



I = _____ amps /2

2. **Repeat problem # 1 but the battery has a voltage of 9.0 volts and each resistor has a value of 27 ohms.**

/2

I = _____ amps

3. **List the four basic elements (parts) of a laser:**

_____

_____

_____ /2

_____

4. **Change the improper fractions to mixed numbers:**

/2

$\frac{5}{3} =$ $\frac{12}{5} =$

5. **Perform the following addition and subtraction of fractions:**

/2

$\frac{5}{3} + \frac{3}{6} - \frac{5}{12} =$

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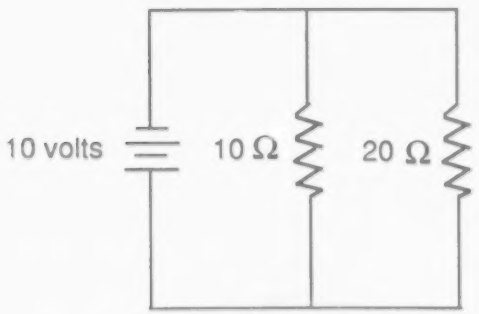
Quiz # 10

1. **Find the total resistance of the circuit below:**



/2

R = _____ ohms

2. **In the circuit above, what is the total current through the battery?**

/2

I = _____ amps

3. **In the circuit of problem # 1, what is the total power dissipated in the resistors?**

P = _____ watts

/2

4. **Perform the indicated operations:**

/2

$\frac{3}{4} - \frac{5}{12} =$ $\frac{5}{9} - \frac{6}{12} =$

5: **Ditto!**

/2

$\frac{3}{4} - \frac{5}{2} =$ $\frac{6}{8} + \frac{3}{2} - \frac{2}{3} =$

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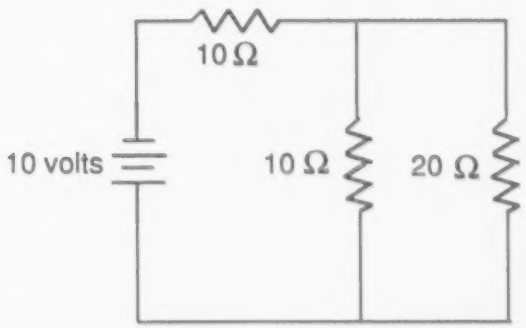
Quiz # 11

1. **Find the total resistance of the circuit below:**

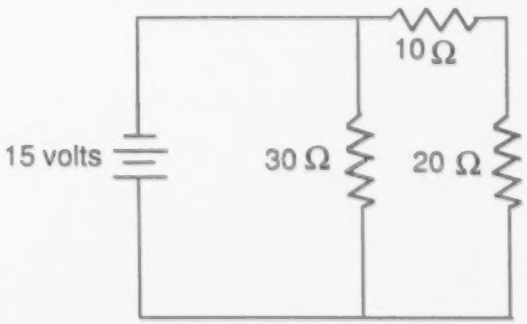


R = _____ ohms /2

2. **What is the current through the battery in the circuit above?**

I = _____ amps. /2

3. **What is the current through the battery in the circuit below?**



I = _____ amps. /2

4. **Protective goggles are to be worn while using a large He-Ne laser (bright red beam). If you look through the laser goggles at a white light, what color will the lenses appear? (circle the best choice)**

black clear red orange blue/green gray /2

5. **Solve the following:**

$\frac{-2}{9} \times \frac{3}{7} =$ ☐ $\frac{-7}{16} \times \left(-\frac{8}{14}\right) =$ ☐ /2

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Quiz # 12

1. Name two ways that you can demagnetize" a permanent magnet.

_____ & _____ /2

2. A *solenoid* is a(n), (circle one)

a. electromagnet with a moving plunger.
b. magnetic storm on the sun (sol).
c. a single, solitary component in a circuit.
d. a disease of the bottom of the foot!
e. None of the above is correct! /2

3. Briefly describe what a relay is.

_____

_____

Draw the schematic symbol for a relay on the back of this page. /2

4. Find the reciprocal of the following numbers and give your answer in decimal form:

reciprocal of $\frac{3}{4}$ = [ ] and of 1.5 = [ ] /2

5. Round of to the nearest hundredths:

(1.50 ÷ 0.60) + 3.80 = [ ]

(2.68 x $\frac{3}{8}$) - (-3.40) = [ ] /2

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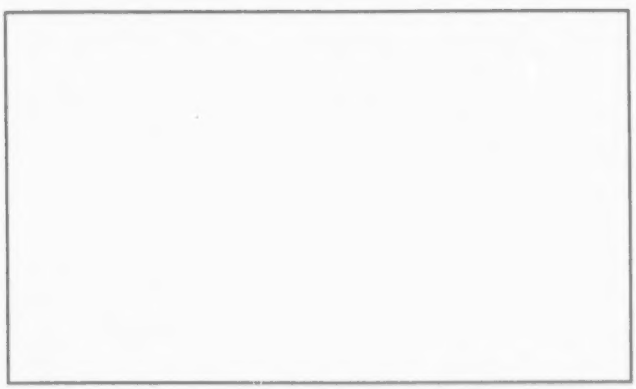
Quiz # 13

1. In the box below, draw a picture of a milliammeter connected to as single shunt resistor.



/2

2. If the full-range sensitivity of the meter above is 1.00 mA and the internal resistance of the meter is 50.0 ohms, what is the required resistance of the shunt if the meter + shunt is intended to read 1.00 amps full scale?

R of shunt = _____ ohms

/2

3. Find the following (you may use your calculators):

$(15.0)^4$ = ____ $(0.295)^3$ = ____

/2

4. And the following:

$\sqrt{150}$ = ____ $\sqrt[3]{216}$ = ____

/2

5. And finally... solve the following:

$(1.41421356)^2$ = ____ $(1.70997595)^3$ = ____

/2

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Quiz # 14

1. A voltmeter is ***always*** connected in _____ with the voltage source or voltage drop which is being measured. /2

2. Explain the term "loading". _____

_____

_____

_____ /2

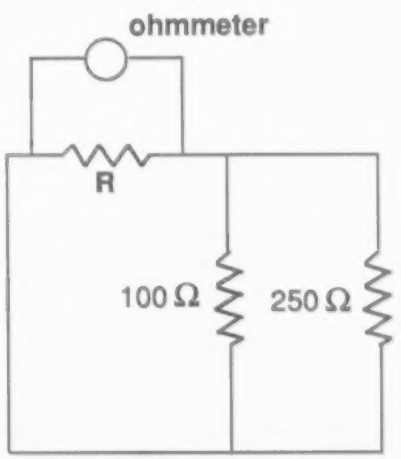
3. The ohmmeter in the circuit on the right reads: (circle one)

a. higher than R

b. lower than R

c. exactly R

d. zero



/2

4. Work out the following:

$(-3)^3$ = _____ $(-5.20)^4$ = _____ /2

5. And the following:

$\sqrt[3]{-27}$ = _____ $\sqrt{-36}$ = _____ /2

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Quiz # 15

1. **What three quantities does a multimeter read?**

_____

_____

_____

/2

2. **Name three accessories that you can use with a typical "electronic" multimeter.**

_____

_____

_____

/2

3. **Work out the following:**

$(\frac{2}{3})^3 =$ ☐ $(\frac{3}{5})^2 =$ ☐

/2

4. **And the following:**

$(3^2)^2 =$ ☐ $((-2)^3)^3 =$ ☐

/2

5. **And finally... the following:**

$(3 \times 2^3)^2 =$ ☐ $\sqrt{6^4} =$ ☐

/2

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Quiz # 16

1. As a car (lead acid) battery is discharged, the amount of sulfuric acid in the battery, (circle the correct answer)

   a. increases. b. decreases. c. remains the same.

   d. There is no sulfuric acid in a car battery!

/2

2. "A magnetic field can generate current in a nearby wire loop." Explain what is incomplete about that statement.

   _____

   _____

/2

3. State the difference between an alternator and a generator in terms of the type of electricity each produces.

   _____

   _____

/2

4. Work out the following using your calculator:

$(3+4^3)+\sqrt{6x24}$ = ☐ $\sqrt[3]{5-13} \div 0.50$ = ☐

/2

5. And the following:

$8.40^{3.80}$ = ☐ $6.20^{2.25}$ = ☐

/2

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Quiz # 17

1. What is the frequency of the A.C. power supplied by the wall outlets in your house?

Hz /2

2. The peak voltage from an A.C. outlet is approximately 311 V. What is the *average* or *RMS* value of the voltage?

volts /2

3. If the peak voltage is 170 V AC what is the peak-to-peak voltage?

volts /2

Work out the following four problems ***without*** using your calculator:

4. Express as powers of 10:

10,000 = 1,000,000 = /2

5. Write out as common decimal numbers:

10^{-4} = 10^{-7} = /2

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Quiz # 18

1. From a measurement on the oscilloscope you find that the period of a wave is 5.00 ms. What is the frequency of the wave?

Hz

/2

2. What is a *cathode ray* ? What does it do in an oscilloscope?

/2

3. The waveform on your oscilloscope is too close to the bottom of the screen. Which control would you use to bring the waveform to the middle of the screen?

/2

4. Work out the following and express your answer in scientific notation.

$(3.60 \times 10^{-4}) \times (6.00 \times 10^{6}) =$

$(5.40 \times 10^{8}) \times (0.850 \times 10^{-6}) =$

/2

5. Do the same for these:

$(3.00 \times 10^{8}) \div (1.50 \times 10^{8}) =$

$(6.60 \times 10^{-4}) \div (3.80 \times 10^{14}) =$

/2

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Quiz # 19

1. In a step-up transformer, the *current* in the secondary coil is

   a. greater than b. less than c. the same as

   the current in the primary coil. (circle the correct answer)

   /2

2. In a step-down transformer, the *voltage* in the primary coil is,

   a. greater than b. less than c. the same as

   the voltage in the secondary coil. (circle the correct answer)

   /2

3. A step-up transformer increases the voltage from 15.0 V AC to 300 V AC. If the current in the primary coil is 100 mA, what is the current in the secondary coil? Assume the transformer has no loss.

   _____ mA

   /2

4. Work out the following and express your answer in scientific notation.

   $\frac{1}{10^{6}} =$ _____ $\frac{1}{10^{-8}} =$ _____

   /2

5. Do the same for these:

   $(3.25 \times 10^{5}) + (1.50 \times 10^{4}) =$ _____

   $(4.50 \times 10^{3}) - (2.50 \times 10^{4}) =$ _____

   /2

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Quiz # 20

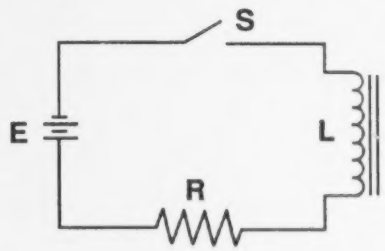
1. List four factors that influence the inductance of a metal core coil.

_____ _____

_____ _____

/2

2. In the circuit on the right, after the switch S is closed the current is,



a. E/R b. less than E/R

c. greater than E/R

d. LR

/2

3. "Current through a coil generates a back-EMF."
Explain what, if anything, is incomplete with this statement.

_____

_____

/2

4. Work out the following and express your answer in scientific notation.

$(3 \times 10^{-6})^2 =$ ____ $(6.40 \times 10^{0})^3 =$ ____

/2

5. Do the same for the following:

$\sqrt{1.96 \times 10^{4}} =$ ____ $\sqrt[3]{27 \times 10^{-3}} =$ ____

/2

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Quiz # 21

1. **Find the inductive reactance of a 1.00 mH coil, driven by a sine wave generator producing a 1.50 kHz signal.**

X_L = _____ Ω

/2

2. **If two inductors identical to the one described in the previous question are driven in series by the same 1.50 kHz signal, what will be the combined reactance?**

X_L = _____ Ω

/2

3. **Now place the same two inductors in parallel with the same signal generator, what is the resulting combined reactance?**

X_L = _____ Ω

/2

4. **Use your calculator to solve the following:**

log (4.62) = _____

log (-5.67) = _____

/2

5. **An audio amplifier has an input of 15.0 mW and an output of 25.0 W What is the gain of the amplifier in decibels?**

Gain = _____ dB

/2

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Quiz # 22

1. **Circle the answer that best describes capacitors.**

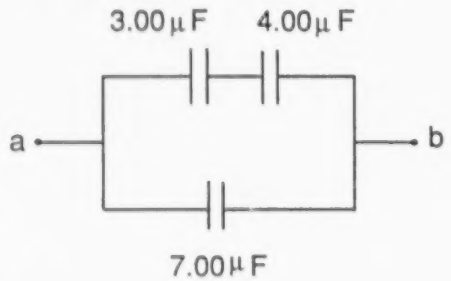
   a) They store energy. b) They have two terminals.

   c) Capacitors may be connected in series only.

   d) All of the above are correct! e) Answers a & b only!

/2

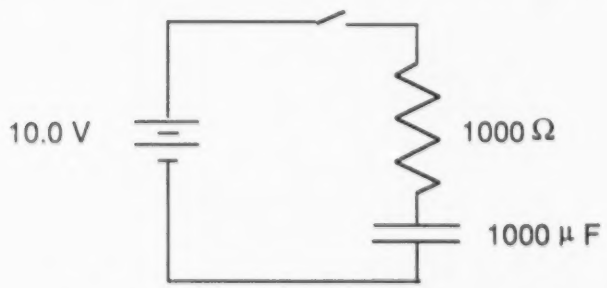
2. **What is the total capacitance between terminals a and b in the circuit below?**



C = _____ μ F

/2

3. **About how long do you have to wait after the switch is closed to "fully" charge the capacitor shown in the circuit below?**



t = _____ sec

/2

4. **Solve the following without using your calculator.**

   antilog (-3) = _____

/2

5. ***Estimate* the following without using your calculator.**

   antilog (2.5) = _____

/2

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Quiz # 23

1. A 1200 microfarad capacitor is connected to a signal generator producing an A.C. voltage at a frequency of 10,000 Hz. What is the capacitive reactance of the capacitor? /2

$X_C =$ _____ Ω

2. If two capacitors identical to the one described in the previous question are driven in series by the same 10,000 Hz signal, what will be the combined reactance? /2

$X_C =$ _____ Ω

3. Now place the same two capacitors in parallel with the same signal generator, what is the resulting combined reactance? /2

$X_C =$ _____ Ω

4. List next to the wavelength range of a laser beam which portion of the eye is most susceptible to laser-induced damage. /2

Ultraviolet _____ Near Infrared _____

Visible _____ Far Infrared _____

5. Using your calculator, solve the following: /2

ln (-6.37) = _____

if $e^x = 4.95$ then x = _____

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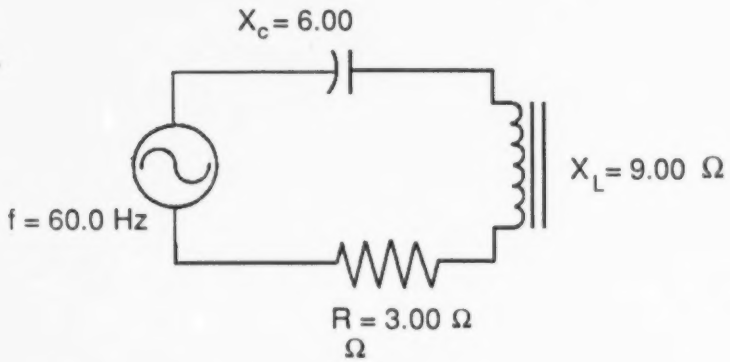
Quiz # 24

1.



What is the total impedance of this circuit?
(Hint: draw a vector diagram.)

Z = _____ Ω /2

2. **What is the resonant frequency of the circuit in the problem above?**

f = _____ Hz /2

3. **A tank circuit is (circle one):**

a) the electronics control circuit of a water tank.
b) the ignition wiring in an Army tank.
c) a parallel arrangement of an inductor and a capacitor.
d) a series resonant circuit.

/2

4. **The impedance of a series circuit is _____ at resonance, while it is _____ for a parallel circuit. (Fill in the blanks)** /2

5. **Perform the following conversions:**

34.0 in = _____ cm = _____ m

45.0 mi = _____ km = _____ cm

/2

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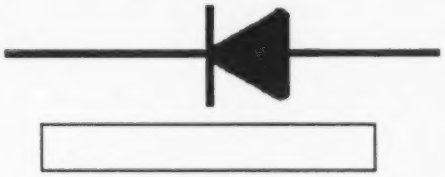
Quiz # 25

1. Below the figure, draw an arrow showing the direction most of the *electrons* flow through the diode.



/2

2. A wave has a wavelength of 2.00 meters and a frequency of 100 Hz. How fast is the wave traveling?

v = _____ m/s

/2

3. From the list of electromagnetic waves given below, circle the one with the *longest wavelength*.

microwaves visible light x rays radio waves

ultraviolet light infrared radiation gamma rays

/2

4. As light travels from air into glass, which of the following properties of the wave *does not change* ? (circle the correct answer)

frequency wavelength speed

/2

5. Next to each of the following prefixes, write in the corresponding power of ten.

kilo = $10^{(\ )}$ milli = $10^{(\ )}$ mega = $10^{(\ )}$ micro = $10^{(\ )}$

pico = $10^{(\ )}$ nano = $10^{(\ )}$ giga = $10^{(\ )}$

/2

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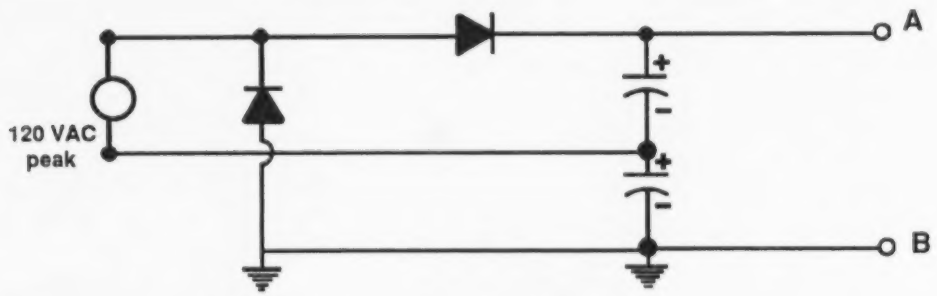
Quiz # 26



1. What is the function of the circuit shown above?

_____

_____

Is the voltage between points A & B AC or DC ? _____

What is this voltage? _____ /2

2. The typical voltage regulator has how many terminals? _____
True or False: voltage regulators regulate AC voltage? _____ /2

3. List the elements of a tetrode vacuum tube:

_____

_____ /2

4. Simplify the following literal expressions by combining like terms.

$3R_1 + 2R_2 + 4R_1 - 6R_2 =$ _____

$I_1 + 6I_1 - I_3 + 3I_2 - 5I_2 =$ _____ /2

5. Simplify the following:

$(27a^3b^6)^{1/3} =$ _____ $4R^2 + (6R)^2 =$ _____ /2

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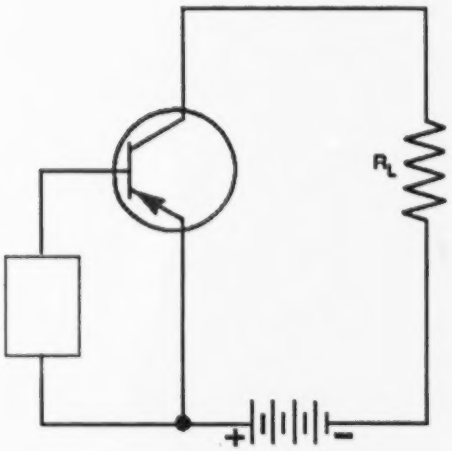
Quiz # 27

1. In the box on the right draw the schematic symbol for an NPN transistor. Label the three connections to the transistor.

/2



2. The transistor shown in the figure above is of what type?

_____

/2

3. In the box connected to the transistor, draw a small battery in such a manner that the transistor will start to conduct. Be sure that the battery is connected in the correct direction.

/2

4. Simplify the following:

$(4a3) \times (3a2) =$ $(6a4) \div (2a2) =$

/2

5. Simplify the following:

$\frac{a^3}{2} \times \frac{4}{a^2} =$ $\left(\frac{a}{2}\right)^2 \div \frac{4}{a^2} =$

/2

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Quiz # 28

1. Opto-couplers are used to provide isolation.
What is it that is isolated? (Circle correct answer.)

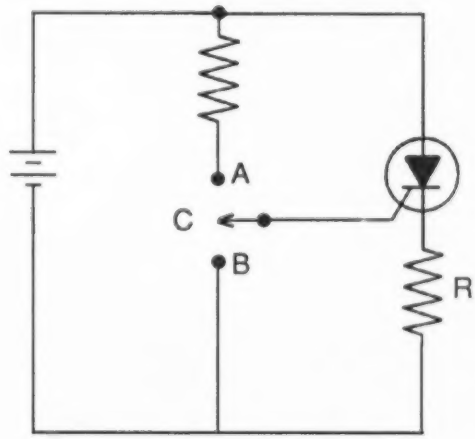
a) AC from DC b) light from electricity

c) current in one part of a circuit from current in another part

d) All of these!

/2

2. In the circuit on the right, current passes through R when, (Circle correct answer.)



a) switch is in position A
b) switch is in position B
c) switch is in center
d) battery is reversed
e) None of the above!

/2

3. List two differences between an ordinary transistor (bipolar) and an FET.

_____

_____

/2

4. Simplify the following:

$b^2 \times 3ac =$ $6a^5c^2 \div ac =$

/2

5. Perform the indicated operation:

$(4a - 2b)(3a + b) =$ $b^2 - 2b + 1 = (\quad)^2$

/2

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Quiz # 29

1. What type of logic gate is shown on the right?

_____

Inputs		Out
A	B	C
0	0	
1	0	
0	1	
1	1	

/2

2. Fill in the "truth table" for the gate above. /2

3. In the box above its name, draw the symbol for each of the logic gates.

AND	XOR	Inverter

/2

4. Convert the following binary numbers to base 10:

10011 = 11001 = /2

5. Convert the following base 10 numbers to binary:

12 = _____ 22 = _____ /2

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score

Quiz # 30

1. Add the following binary numbers:

/2

$$\begin{array}{r} 101 \\ +\ 1001 \\ \hline \end{array} \qquad \begin{array}{r} 100 \\ +\ 101 \\ \hline \end{array}$$

2. The two main classes of IC's are digital and _____.

An OP Amp is (circle correct answer):

a) an amplifier built by Ocean Pacific,
b) an operational amplifier,
c) a linear amplifier
d) both answers b and c above,
e) None of the above is correct!

/2

3. Write the complete term for each of the following abbreviations:

CRT: _____

ROM: _____

CPU: _____

/2

4. Add the hexadecimal numbers A + C + D and express the answer in decimal (base 10) form:

_____

/2

5. Express the following numbers in BCD:

16 = _____ 32 = _____

/2

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Quiz # 31

1. **Which class of amplifier amplifies both the upper and lower half of the wave form with minimal distortion?**

   Class _____ . /2

2. **Which two classes of amplifiers are typically use in a "push-pull" configuration?** /2

   Class _____ and class _____.

3. **In the box below, sketch a common collector amplifier using a single NPN transistor. Show the input and output of the circuit as well as the batteries needed for proper biasing. Circuit values do not have to be given.**

   /2

4. **In Problems $ & 5, solve for the unknown in each case:** /2

   x+6 = 10 **x = _____ ,** **x - 6 = 13** **x = _____**

5. **$2x + 4 = x + 6$** **x = _____,** **$y^2 + 5 = 21$** **y = _____** /2

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Quiz # 32

1. When an atom absorbs a photon, (circle the correct answer)

   a) the photon is "destroyed" and the atom moves to a high energy state,
   b) the atom is destroyed,
   c) only part of the photon's energy is absorbed,
   d) a proton is emitted spontaneously.
   e) None of the above is correct!

   /2

2. The three means of heat transfer are, (circle the correct answer)

   a) conduction, convention, and irradiation.
   b) conduction, convection, and oscillation.
   c) transduction, reflection, and radiation.
   d) conduction, convection and radiation.
   e) None of the above is correct!

   /2

3. Write down two advantages of fluorescent lighting when compared to incandescent lighting.

   _____

   _____

   /2

4. Solve for x in the following equations:

   $5x - 3 - 12 - 8x = 0$ x = _____

   $(2x + 6)(x - 4) = 0$ x = _____ and _____

   /2

5. Given Ohm's Law V = IR,

   Suppose that V = 10 volts and R = 0.20 ohms, find I.

   I = _____ Amps.

   /2

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Quiz # 33

1. What does the term "modem" mean?

_____

_____

/2

2. What is the purpose of the intermediate frequency (IF) stage in a modern radio receiver?

_____

_____

_____

/2

3. In T.V. pictures, what is meant by "interlaced scanning"?

_____

_____

_____

/2

4. The light from a He-Ne laser operating on the visible red line has a frequency of 4.741×10^{14} hertz. Use the expression $E = hf$ to find the energy of one photon. Planck's constant $h = 6.626 \times 10^{-34}$ J-sec. Express your answer in scientific (powers-of-ten) notation.

E = _____ Joules

/2

5. Given that $x + y = 5$ and $2x - y = 10$, find x and y.

x = _____ and y = _____

/2

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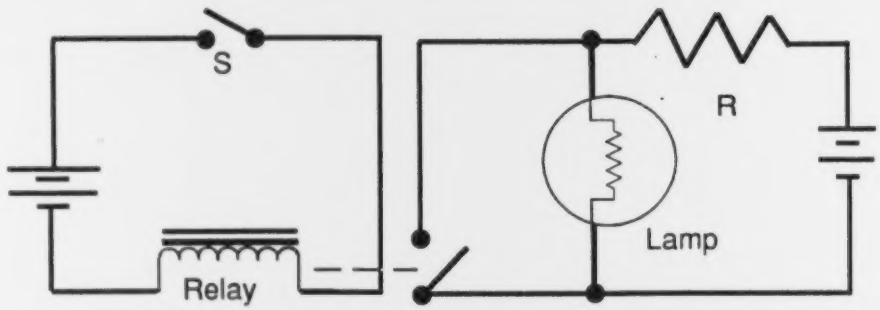
Quiz # 34

1.



In the circuit above, what will hapen to the lamp when switch S is closed?

_____ /2

_____

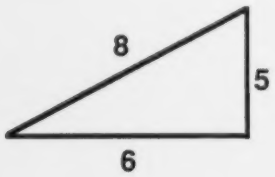
2. True or False (Circle correct answer)

In a closed loop control system, the computer does not know for sure if the robot executed the instruction it was given. /2

3. The excitation mechanism in most gas lasers is _____ _____, while in solid lasers a _____ is typically used to excite the gain medium. /2

4. Are the dimensions of the triangle on the right correct?

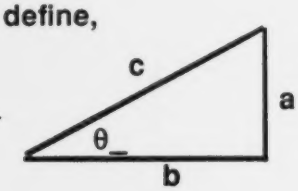
Circle: yes no can't tell



/2

5. Using the letters for the sides of the triangle define,

sin θ = _____ cos θ = _____ tan θ = _____



/2

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Quiz # 35

1. What is the purpose of the ignition coil in an automotive electrical system?

_____

_____

/2

2. Which of the following types of residential wire cable uses a flexible outer metal conduit for protection? (Circle correct answer)

Romex BX NM NMC

/2

3. Which of the following types of optics can be cleaned with a fine abrasive polishing compound? (Circle all that apply)

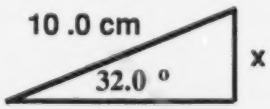
coated laser mirrors uncoated laser windows

aluminum coated mirrors anti-reflection coated lenses

/2

4. For problems 4 & 5, use your calculator to find the missing side of the triangle.

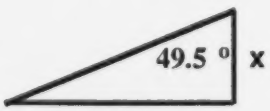
Drawings are not to scale!



x = _____ cm

/2

5. x = _____ cm



/2